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Indian Standard

SPECIFICATION FOR GLASS-FIBRE WOVEN TAPE FOR ELECTRICAL PURPOSES

(Second Revision)

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NEW DELHI 110002

Gr 3 *June* 1988

Indian Standard

SPECIFICATION FOR GLASS-FIBRE WOVEN TAPE FOR ELECTRICAL PURPOSES

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards on 5 February 1988, after the draft finalized by the Narrow Fabrics, Webbings and Braids Sectional Committee had been approved by the Textile Division Council.

0.2 This standard, first published in 1969, was revised in 1974. This standard has been again revised on the basis of experience gained during its use. The important changes are:

a) Preferred nominal widths of tapes have been specified for each nominal thickness.

b) Requirements of 0·09 mm thick tapes have been specified in place of 0·08 mm thick tapes.

c) Positive tolerance on thickness has been widened.

0.3 In the preparation of this standard, assistance has been derived from BS 3779 : 1985 'Specification for glass and glass polyester fibre woven tapes for electrical purposes', issued by the British Standards Institution.

0.4 Glass-fibre woven tapes conforming to this specification are intended for use in transformers, industrial machines, turbo-generators and water-wheel alternators.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard prescribes the constructional particulars and other requirements of continuous-filament glass-fibre woven tapes suitable for electrical purposes.

1.2 This standard covers tapes of widths 10 to 50 mm with nominal thickness 0·09 to 0·28 mm.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Filament — A single glass fibre as drawn.

2.2 Strand — A plurality of filaments bonded with size.

2.3 Yarn — A number of strands put together with twist.

2.4 Linear Density — The mass in grams per kilometre of strand (tex).

2.5 Size — A mixture of organic materials applied to the strand during manufacture to facilitate yarn processing and weaving.

3. CLASSIFICATION

3.1 Tapes are classified by a number representing a nominal thickness in hundredths of a millimetre followed by a hyphen and a number indicating the type of construction available within the same nominal thickness group. Thus the designation 18-3 indicates a tape of nominal thickness 0·18 mm having a medium closeness of weave (*see* Table 1).

NOTE — The indication of comparative closeness of the weave is intended to facilitate selection of tapes from a thickness group and as a guide when considering usage factors such as varnish impregnation.

4. MANUFACTURE

4.1 The yarn used in the manufacture of the tape shall be continuous-filament glass-fibre (usually known as 'E' glass) containing not more then 1 percent of alkali calculated as sodium oxide. The tape shall be woven in plain weave with selvedges. The selvedges shall be uniform. The tape shall be in the loom-state condition and shall not be calendered.

5. REQUIREMENTS

5.1 The tape shall comply with the requirements specified in Table 1.

TABLE 1 PARTICULARS OF GLASS-FIBRE WOVEN TAPES

(*Clause* 5.1)

TAPE No.	THICKNESS	COMPARATIVE CLOSENESS OF WEAVE	WARP LINEAR DENSITY, APPROXIMATE	WEFT LINEAR DENSITY, APPROXIMATE	ENDS PER cm, *Min*	RANGE OF PICKS PER cm	TENSILE STRENGTH IN WARP DIRECTION, *Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			tex (*see* Note)	tex (*see* NOTE)			N/mm of Width
9-1	$0{\cdot}09^{+0{\cdot}02}_{-0{\cdot}01}$	Open	11 × 1 × 2	11 × 1 × 2	25	17—19	18
9-2		Medium	5·5 × 1 × 2	11 × 1 × 2	41	17—19	16
9-3		Medium	5·5 × 1 × 2	11 × 1 × 2	40	20—22	14
13-1	$0{\cdot}13^{+0{\cdot}04}_{-0{\cdot}01}$	Open	11 × 1 × 2	22 × 1 × 2	19	13—15	14
13-2		Medium	22 × 1 × 2	11 × 1 × 2	24	16—17	33
13-3		Medium	11 × 1 × 2	22 × 1 × 2	25	15—17	18
13-4		Close	11 × 1 × 2	11 × 1 × 2	41	15—16	30
18-1	$0{\cdot}18^{+0{\cdot}03}_{-0{\cdot}02}$	Open	33 × 1 × 2	33 × 1 × 2	14	12—13	26
18-2		Open	22 × 1 × 3	22 × 1 × 2	14	12—13	30
18-3		Medium	22 × 1 × 3	22 × 1 × 2	20	12—13	42
18-4		Close	33 × 1 × 2	22 × 1 × 2	21	9—10	37
23-1	$0{\cdot}23^{+0{\cdot}03}_{-0{\cdot}02}$	Medium	33 × 1 × 2	22 × 2 × 3	21	8—9	37
23-2		Medium	22 × 1 × 3	22 × 1 × 3	21	13—15	42
23-3		Close	33 × 1 × 2	33 × 1 × 2	21	13—15	37
28-1	$0{\cdot}28^{+0{\cdot}03}_{-0{\cdot}02}$	Medium	22 × 1 × 3	22 × 2 × 3	20	8—9	42
METHOD OF TEST	IS : 7702-1975*	—	—	—	A-3	A-4	A-5

NOTE — Linear density is designated by $A \times B \times C$ where A indicates the linear density of strand, B indicates the number of strands twisted to make a yarn and C indicates the number of such yarns cabled together. Thus 22 × 2 × 3 indicates that two strands of 22 tex have been twisted together to make a yarn and that three of such yarns have been cabled together to make the thread.

*Methods for determination of thickness of woven and knitted fabrics.

5.2 Length — Unless otherwise specified, the tape shall be supplied in rolls of 50 m length. The number of joints per roll shall not exceed two, and none of the jointed length in a roll shall be shorter than 10 m. The length of the tape in each roll shall be determined by the method prescribed in IS : 1954-1969*.

5.2.1 Where joints occur, the tape shall be butted and joined up by a strip of coloured gummed tape which shall show on the edge of the reel to indicate the presence of a joint. Pins or other metal fasteners shall not be used for securing the ends of rolls or for joining the tape.

5.3 Width — Preferred nominal widths of tapes are given in Table 2. Other widths may be supplied by agreement between the purchaser and the manufacturer.

TABLE 2 PREFERRED NOMINAL WIDTHS

NOMINAL THICKNESS (1) mm	PREFERRED NOMINAL WIDTHS (2) mm
0·09	10, 12·5, 20, 25, 32, 40 and 50
0·13 0·18 0·23 0·28	12·5, 20, 25, 32, 40 and 50

5.3.1 The width of the tape as determined in accordance with **A-2** shall not differ from the specified value by more than:

a) ± 1·0 mm for nominal widths up to and including 25 mm, and

b) ± 1·5 mm for nominal widths over 25 mm.

5.4 Effect of Heating in Air — The tape after being heated in air in a loosely coiled state for 24 hours at 250 ± 10°C and subsequently cooled to atmospheric temperature shall have tensile strength not less than 50 percent of the value (*see* col 8 of Table 1) of that obtained on the unheated tape; the specimens being drawn from the same rolls as those used for breaking load test on unheated tapes.

5.5 Glass Content — The glass content of the tape, as determined in accordance with the method prescribed in **A-6**, shall be not less than 97·5 percent.

5.6 *p*H Value — The *p*H value of aqueous extract, as determined in accordance with IS : 1390-1983† (hot method) shall be between 8 and 10.

5.7 Electrical Conductivity — The electrical conductivity of the aqueous extract, as determined in accordance with IS : 4420-1967* shall be not more than 70 μS/m.

6. PACKING

6.1 The tape shall be wound on a hard tubular core of sufficient strength to withstand the pressure of the tape when wound tightly on it. The internal diameter of the core shall be not less than 10 mm and not more than 13 mm and its width shall be approximately the same as the width of the tape but shall not exceed it. The core shall not be loosened when dropped on floor from a height of one metre.

6.2 A set of 10 rolls shall be wrapped in polyethylene film and the sets packed in bundles or cases as agreed to between the buyer and the seller.

7. MARKING

7.1 Each roll shall be legibly marked at both ends with the following information:

a) Tape number;

b) Length in metres and width in millimetres;

c) Manufacturer's name, initials or trademark, if any; and

d) Year of manufacture.

7.1.1 Each roll may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

8. SAMPLING

8.1 Lot — The quantity of tape of one definite variety delivered to one buyer against one despatch note shall constitute a lot.

8.2 The conformity of a lot to the requirements of this standard shall be determined on the basis of tests carried out on rolls of tape selected from the lot.

8.3 Unless otherwise specified, the number of rolls of tape to be selected at random from a lot shall be as given in Table 3.

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*Methods for determination of length and width of fabrics (*first revision*).

†Methods for determination of *p*H value of aqueous extracts of textile materials (*first revision*).

*Method for determination of conductivity of aqueous and organic extracts of textile materials.

TABLE 3 SAMPLE SIZE AND CRITERIA FOR CONFORMITY

(*Clause* 8.3)

Lot Size (Number of Rolls) (1)	Sample Size (2)	Permissible Number of Defective Rolls (3)	Sub-Sample Size (4)
Up to 100	5	0	2
101 to 300	13	0	3
301 to 500	20	1	5
501 to 1 000	32	2	8
1 001 and above	50	3	8

8.4 For evaluating width, length, ends per centimetre, picks per centimetre and thickness, the number of rolls selected in col 2 of Table 3 shall constitute the test sample.

8.5 For evaluating tensile strength, *p*H value, conductivity of aqueous extract, effect of heating in air and glass content, the number of rolls selected in col 4 of Table 3 shall constitute the test sample. The rolls shall be selected at random from those drawn for the purpose of **8.4**. The required test specimens shall be drawn from each of the rolls and subjected to corresponding tests.

8.6 Criteria for Conformity — The lot shall be considered to be in conformity with the requirements of this standard if the following conditions are satisfied:

a) The number of rolls found defective for any one or more of the characteristics mentioned in **8.4** does not exceed the corresponding number given in col 3 of Table 3.

b) None of the test samples shall fail for any of the characteristics mentioned in **8.5**.

APPENDIX A

(*Clauses* 5.3.1, 5.5 and *Table* 1)

METHODS OF TEST

A-1. ATMOSPHERIC CONDITIONS FOR TESTING

A-1.1 All tests may be carried out under prevailing atmospheric conditions. However, while determining tensile strength, in all cases of disputes, the test specimens shall be conditioned to moisture equilibrium in a standard atmosphere at 65 ± 2 percent relative humidity and 27 ± 2°C temperature (*see* IS : 196-1966*) for 6 hours and tests shall be carried out in standard atmosphere.

A-2. WIDTH

A-2.1 Test Specimens — Each roll in the test sample shall constitute a test specimen.

A-2.2 Equipment — A steel measuring rule graduated in millimetres.

A-2.3 Procedure — Unroll the tape and lay it on smooth surface. Apply no more tension to it than is necessary to make it lie straight and flat. Measure the width of tape by means of the steel measuring rule to the nearest millimetre. Make two measurements at random for each test specimen. Take the mean value of the two measurements as the width of the tape. Similarly determine the width of other test specimens.

A-3. ENDS PER CENTIMETRE

A-3.1 Test Specimens — Each roll in the test sample shall constitute a test specimen.

A-3.2 Procedure — Count the number of ends across the full width of the tape and using the value for the measured width of the tape, calculate the number of ends per centimetre. Similarly determine the ends per centimetre of other test specimens.

A-4. PICKS PER CENTIMETRE

A-4.1 Test Specimens — Each roll in the test sample shall constitute a test specimen.

A-4.2 Procedure — Count the number of picks over not less than 25 mm length of the tape at minimum three different places along the length. From the value thus obtained, calculate the picks per centimetre. Similarly determine the picks per centimetre of the other test specimens.

A-5. TENSILE STRENGTH

A-5.1 General — The tensile strength shall be determined by the methods prescribed in IS : 1969-1985*. However, in this case, the conditions listed in **A-5.2** to **A-5.5** shall be applicable.

A-5.2 Test Specimens — From each roll in the test sample, draw at least one test specimen of sufficient length to allow an unstretched length of 200 mm between the jaws of the testing machine.

A-5.3 Preparation of Test Specimens — In order to prevent differential slips of yarns held in the clamps and cutting or abrasion of the tape before or during tests; Bollard type clamps have been found suitable for the purpose. Where these are not available, effective means

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*Atmospheric conditions for testing (*revised*).

*Methods for determination of breaking load and elongation of woven textile fabrics (*second revision*).

of gripping and protecting the tape in clamp type grips may be ensured by securing each of the specimen to stiff paper with a suitable cement, rubber or vinyl solution, polyvinyl butyral in sheet form and thermosetting adhesive tape. Care should be taken to lay the specimen on a flat surface during the application of the reinforcement so as to ensure that the warp threads are at a uniform tension.

A-5.4 Application of Load — Apply the load so that the time taken from the commencement of the load to the moment at which the specified minimum load is reached in 30 ± 5 seconds and continue until the test piece breaks. If the test piece breaks unevenly, or in or at a jaw of the testing machine, discard the result and make a further test using another test piece.

A-5.5 Result — Calculate the tensile strength in Newtons per millimetre width by dividing the value of the breaking load by the measured width in millimetres.

A-6. GLASS CONTENT

A-6.1 Test Specimen — Cut a piece of tape weighing not less than 5 g from each roll in the test sample.

A-6.2 Procedure

A-6.2.1 Dry the specimen in an oven at 105 to 120°C for 1 hour. Allow the specimen to cool in a desiccator at room temperature, remove it and weigh immediately to the nearest milligram, observing the usual precautions to prevent loss in weight.

A-6.2.2 Transfer the specimen to a suitable vessel and place it in a muffle furnace at a temperature of 600 ± 10°C for 2 hours to remove the organic matter. Remove the specimen from the furnace and transfer immediately to a desiccator. When cool, remove the specimen from the desiccator and weigh immediately as before.

A-6.3 Calculate the glass content of the tape as a percentage of the weight of the dried specimen.

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